

2024

S2 EP7: A Guide to Nebulae

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EPISODE 7



**ASTROPHYSICS: DEEP IN THE SPACE
WITH MAANVINDER PILANIA**

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A Guide to Nebulae

Hello and welcome back to the part 2 of season 2 of this astronomy podcast. I'm your host Maanvinder and I will be taking you on another journey through cosmos and this time we will wander through the stellar nurseries where stars are born and that magical place is called nebulae. Now that you have a basic understanding of what are they but what they really are? In this episode, I will be talking about it, their types and will try to tell you about some beautiful nebulae that are helping astronomers understand the life cycle of a star from its birth to death. In other words Nebulae are a place where a star rises from the dead. Let's get started

Nebulae are vast cloud of dust, hydrogen, helium and other ionized gases. The singular for it is Nebula. You will certainly be surprised finding out how they are formed because it is very interesting and you will definitely find it to your like. They can be formed by two ways either it is from supernova explosions or in a molecular cloud. So what happens in the earlier case is that when a star dies in a supernova explosion, it blasts out its outer layers, thus ejecting all the material that includes gases, dust and elements. In the process, the material ejected forms a shell like structure, moving outwards from the site of explosion and is called a Supernova Remnant. What triggers the star formation or I say makes them a nebula is the shock wave from the explosion which compress the nearby gas and dust, forming new star making regions within the remnant. Now let's talk about the later, which is as part of star formation in molecular clouds. A molecular cloud is also a kind of a nebula but it mainly consists of molecular hydrogen, along with carbon monoxide and ammonia. They are denser and colder regions where star formation is actively happening comparing with nebula such as a supernova remnant.

Now I want to shed the light for you on types of nebulae in the universe.

1. **Planetary Nebula**- When a star like our sun dies, it doesn't explode into a black hole or a neutron star. Instead, it shed its outer layers, which forms a beautiful cloud of glowing gas and dust due to the heat from the star's core which ends up becoming a white jewel at the centre of the nebula. The best example of such nebula is the *Ring Nebula*. Located in the constellation Lyra about 2000 light years from the Earth, it also known as Messier 57. It was created when a Sun like star died during its red giant phase, by shedding its outer layers, leaving only a white bejeweled core at the centre and forming a planetary nebula surrounding it. Remember, I talked about the red giant, white dwarf and black dwarf phase of a main sequence star by taking Sun as an example. You might wanna check those three episodes out if you don't get it. At the centre of this nebula is a white dwarf and is 200 times more luminous than the Sun.

2. **Dark nebula-** A dark nebula or an absorption nebula is a dense cloud of interstellar dust and gas that completely blocks out the visible light from objects behind it. I can name few Nebulae that fall under this category but I will like to tell you about one of my favorite. When I saw its picture, I was amazed and shocked that despite being a dark nebula, it is so beautiful. *Coalsack nebula* or Caldwell 99 is a dark nebula located in the constellation Crux, about 600 light years from the Earth. It is so dark that it blocks out light from any object behind it and is about 100 light years across. On a clear night, it can be seen as a dark patch obscuring a part of the Milky Way in the sky.
3. **Emission Nebula-** It is formed due to the high energy UV radiation from the newly born stars which ionize the surrounding gas. This type of emission nebula is known as HII region. The other type of emission nebula is the planetary nebula in which a dying star has blown off its outer layers and the hot core ionizes the surrounding gas. So you can include the planetary nebula I discussed earlier as one of the type of emission nebula. One of the best examples of HII region are the *Heart Nebula* and *Soul Nebula*, together which are known as Heart and Soul nebula. Both of them are located about 6000 light years from the Earth in the Perseus arm of our galaxy, in constellation Cassiopeia. Another example of emission nebula is the famous *Bubble Nebula* or NGC 7635. It is located about 8000 light years in the constellation Cassiopeia. It is called Bubble nebula because of a bubble created by the stellar winds from a young star known as SAO 20575. The star is located at its centre and is about 45 times massive than our Sun. The bubble nebula is a massive cloud of gas and dust that is about 10 light years across and is also an HII region because the stellar winds from the central star have ionized the gas in the nebula. The star is about 4 million years old and comparing it with the Sun which is 4.6 billion years old, its lifetime is very short because the more massive a star the faster it runs out of its fuel. That's why Red Dwarf stars have an age of trillions of years because they are small compared to other stars and burns their fuel slowly. This star is now burning helium after losing all its Hydrogen and in about 10 to 20 million, the star will end its life in a supernova explosion. Emission nebula often appears reddish or pinkish due to the light emitted by the ionized Hydrogen gas.
4. **Reflection Nebula-** A nebula which glows because of the light from an embedded star which illuminates its dust. Unlike other types of nebula, the Reflection nebula does not emit light of its own. The best example to explain this kind of nebula is *NGC 1999*. It is located in the constellation Orion at around 1500 light years from the Earth. What illuminates this nebula is a variable star called V380. A variable star is a star whose brightness changes with time and are used by astronomers to measure distances across the Universe. The star is located at the centre of this nebula and the light from it illuminates this nebula.

Another interesting thing about this nebula is that there is a one more nebula present inside the same nebula. Near the centre of NGC 1999, there is a dark cloud which resembles letter 'T' from the English alphabets. This type of dark nebula is called Bok Globule and that means star formation is taking place in that dark cloud near the centre of NGC 1999. They often appear blue because they reflect more blue light than any other light. Fascinating is it not? Universe does surprise you in a way you never know whether it's possible or not.

5. **Supernova Remnant-** A Supernova remnant is a type of nebula which is result of a supernova explosion in which a star dies. They distribute heavy elements throughout the universe, they borrowed to form them and now the ejected material will contribute to the formation of new stars. One of my favorite supernova remnant is Cassiopeia A, located about 11,000 light years in the constellation Cassiopeia. It is a remnant of a dead star, which astronomers believe was about five times the mass of Sun before its brutal death. One fun fact, in 2013, Phosphorus was detected in it, confirming that this element is born inside a supernova.

This is all from me for this episode but hey I'll be back with a new guide to guide you through this vast cosmos. thank you!!

Archive Blog: <https://astromaanvinder.blogspot.com>